Electrophoretic Focusing: An Alternative to Capillary Electrophoresis, Phase I

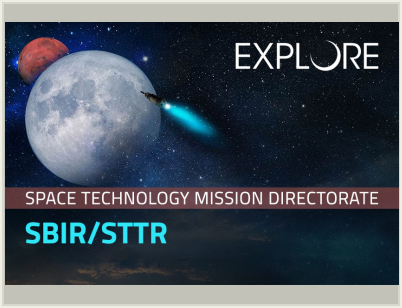
Completed Technology Project (2004 - 2004)

Project Introduction

Electrophoretic focusing is a new separation method intended to achieve high resolution within very short sample residence times because one fraction is separated at a time instead of all fractions at once, a characteristic of capillary and other zonal separation systems. Sample is inserted within a continuous buffer flow steam as a thin lamina and is collected in a single port at the exit end of the chamber. Applying an electric field transverse to the incoming sample and opposing this field with a carefully configured buffer flow a sample constituent can be selected and focused into the collection port for subsequent analysis. Monotonically changing either electric field or buffer cross-flow will yield a scan of the entire sample population. Stopping the scan increases the collection time for minor constituents. Extraneous sample is deflected out of the separation chamber through porous walls while the selected sample is focused in the center-plane of the separation chamber and collected without contact or interaction with the walls. Adverse effects of electroosmosis and other spurious flows are minimal. The design limits Joule heating and electrohydrodynamics during the electrophoresis process and thus should achieve a high resolution of separation in an analytical or preparative mode.

Anticipated Benefits

A porous gel rather than a free-fluid is necessary on Earth to eliminate buoyancy-driven thermal convection. Although gel electrophoresis in its two-dimensional format is the universal laboratory separation method for resolving protein and macromolecular populations, it does not produce unaltered fractions. The success of gel systems for analytical electrophoresis does not satisfy the continuing need for large quantities of purified biological materials for research and production. Unfortunately new free-fluid electrophoresis systems are still limited by thermal convection. Electrophoretic Focusing has been invented to eliminate all sources of sample distortion and replace gel-based eletrophoresis systems. Electrophoresis has been a part of space payloads since Apollo 14 when a pharmaceutical company wanted an improved influenza vaccine. Continuous flow electrophoresis, the dominant free fluid separation technique of the times, is limited as a preparative technology by gravity-dependant thermal convection. During the next thirty years, more than a dozen experiments sponsored by industries in the U.S. and abroad were done in space. This activity peaked with a cooperative venture between McDonnell Douglas Aerospace and Johnson and Johnson Pharmaceuticals that designed and built the flight hardware on five Shuttle missions to make large quantities of a proprietary drug.



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Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Center / Facility:

Marshall Space Flight Center (MSFC)

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

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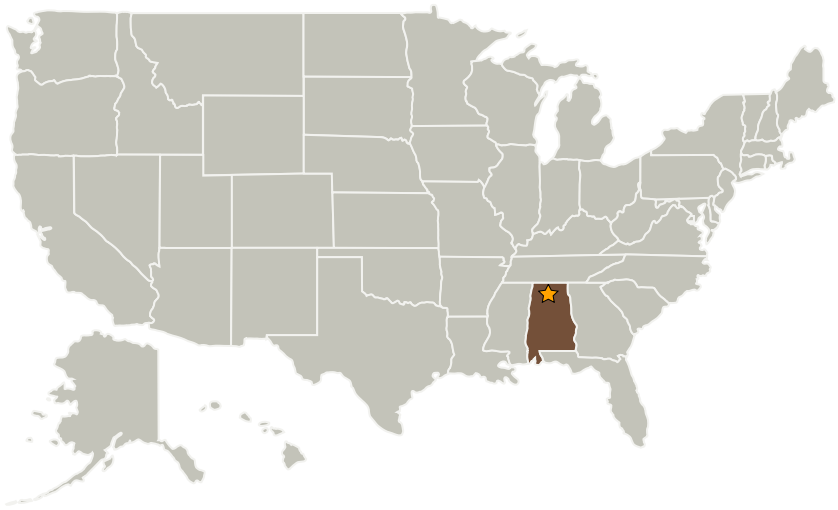
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Marshall Space Flight Center(MSFC)	Lead Organization	NASA Center	Huntsville, Alabama
New Century Pharmaceuticals, Inc.	Supporting Organization	Industry	Huntsville, Alabama

Primary U.S. Work Locations
Alabama

Project Management

Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Project Manager:
Robert Richmond

Principal Investigator:
Robert L Snyder

Technology Areas

Primary:

- TX11 Software, Modeling, Simulation, and Information Processing
  - TX11.3 Simulation
    - TX11.3.7 Multiscale, Multiphysics, and Multifidelity Simulation